Empathising and Systemising in High Anxiety States: An Investigation of Anxiety as a Mechanism for Divergence in Cognitive Performance

Paul Arthur Strutt

BSocSc, GDipPsych(PG) *(University of Newcastle)*

Thesis submitted in fulfilment of the requirements of the Doctor of Philosophy

May 2017

University of Newcastle

Statement of Originality

This thesis contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository**, subject to the provisions of the Copyright Act 1968.

***Unless an Embargo has been approved for a predetermined period.*

Mr Paul Strutt Date

Statement of Collaboration

I hereby certify that the work embodied in this thesis has been completed in collaboration with other researchers. As part of this thesis, I have included a statement that clearly outlines the extent of collaboration, with whom, and under what auspices.

Mr Paul Strutt Date

Statement of Authorship

I hereby certify that the work embodied in this thesis contains a published paper of which I am a joint author. I have included as part of the thesis a written statement, endorsed by my supervisor, attesting to my contribution to the joint publication.

Mr Paul Strutt Date

Copyright Permission

I warrant that I have obtained, where necessary, permission from the copyright owners to use any third party copyright material reproduced in the thesis (i.e. questionnaires, artwork, unpublished letters), or to use any of my own published work (e.g. journal articles) in which the copyright is held by another party (e.g. publisher, co-author).

Mr Paul Strutt Date

Statement of Contribution for Chapter 2

I attest that the Research Higher Degree candidate **Paul Strutt** contributed to the paper entitled:

High anxiety levels are associated with divergent empathising and systemising tendencies.

By contributing to:

- Conceiving the research question
- Formulating the methodology and constructing surveys
- Recruiting participants
- Analysing the data
- Interpreting the data
- Preparing and submitting the manuscript

Co-authors:

Dr Linda Campbell	Date
A/Prof Darren Burke	Date

Publications Completed During Candidature

Campbell, L. E., McCabe, K. L., Melville, J. L., **Strutt, P. A.,** & Schall, U. (2015). Social cognition dysfunction in adolescents with 22q11.2 deletion syndrome (velo-cardio-facial syndrome): relationship with executive functioning and social competence/functioning. *Journal of Intellectual Disability Research*, *59*(9), 845–859. doi:10.1111/jir.12183

Strutt, P. A., Campbell, L. E., & Burke, D. (2014). High anxiety levels are associated with divergent empathising and systemising tendencies. *Cogent Psychology*, *1*(1), 981973. doi:10.1080/23311908.2014.981973

McCabe, K., Melville, J., Rich, D., **Strutt, P. A.,** Cooper, G., Loughland, C., … Campbell, L. (2013). Divergent patterns of social cognition performance in autism and 22q11.2 deletion syndrome (22q11DS). *Journal of Autism and Developmental Disorders*, *43*(8), 1926-1934. doi: 10.1007/s10803-012-1742-2

Conference Presentations

Goodwin, J., **Strutt, P.,** Dudding-Byth, T., Campbell, L. E. (2014) Psychological growth in parents of children with genetic neurodevelopmental conditions: Preliminary results. 49th Annual Australasian Society for Intellectual Disability (ASID) Conference, Fremantle.

Strutt, PA., Burke D., Campbell LE. (2013) Mechanisms for Cognitive Divergence: Visual Attention Strategies and Anxiety Levels Predict the Relationship between Empathising-Systemising Abilities. Australasian Society for Psychiatric Research Conference, Melbourne.

Strutt, PA., Burke, D., Campbell, LE. (2013) Anxiety levels predict empathizing-systemizing levels and social competence. Australasian Experimental Psychology Conference, Adelaide.

Acknowledgments

Since the beginning of my PhD I often wondered what it was going to be like to write the final section of my thesis, these acknowledgments, and if I'm being completely honest, it is everything I imagined it would be. I feel a weight being lifted from my shoulders and a growing sense of accomplishment, my beautiful wife and baby boy are enjoying a well-earned nap just a few metres from where I sit, and my dog, Wynston, my loyal sidekick, is passed out on the couch by my side. I'm very lucky to be able to say that I have everything I could ever have hoped for and the completion of this PhD is testament to that.

There are, of course, lots of people that I have to thank for helping me to get to this position. Firstly, to my supervisor, Associate Professor Darren Burke, most fundamentally, you have been the finest exemplar of academic integrity that I have come to know during my time as a student and graduate researcher. Thank you for taking a punt on an underdog. You may not remember, but early on in my PhD you referred to me as Ned Kelly, likely in reference to my dishevelled beard at the time, but it has resonated with me ever since. We navigated a difficult path to get here, and I wasn't sure whether I would be a good fit for academia, but with your mentorship I have found my place and it is one in which I am now confident I can make a positive contribution. To my co-supervisor, Dr Linda Campbell, it's clear that your genuine compassion for others is what drives your success in research, teaching, and practice. You went above and beyond your obligations as a student supervisor to ensure that I would be successful in my research endeavours. These lessons of integrity and compassion are ingrained in my approach to research and clinical practice and I will maintain those values throughout my career. For that I owe a debt of gratitude to you both.

To my family, you have showed unwavering love and have supported every decision I have made throughout this journey. To Mum and Dad, it is because of you that my outlook on life is one of boundless opportunity. I have grown up believing that anything is possible and that's because I witnessed every day what you were able to achieve in your own lives. To Dani and Georgia and to the Latter family, working on a PhD can be an isolating experience but being surrounded by amazing people like you has always reminded me of the most important thing in my life - my family. Thanks for putting up with my grumpy moods and my occasional absences from events when I needed to keep working. Many parts of my life have changed during the course of this PhD, but the one thing that has remained constant, and for which I am most grateful, is the family that I have around me. To Arthur, I finally finished your coffee table book. I'm sorry it took a little longer than we had planned.

To my PhD buddies, Danielle, Nick, Jane, and Christy, thanks for sharing an office with me over the years. It seemed that one day we were going about our business as usual, and the next we had all suddenly moved on to the next stages of our careers. That office was a happy place. I wish you all the best for your future and have no doubt you'll all be successful. I want to hear about it all some day.

Finally, to my wonderful wife Kate, I have already spent close to half of my life with you, you have been my rock and my greatest supporter, and without you I would never have been able to get here. We did this together every step of the way, so this is as much my achievement as it is yours. Thank you for always believing in me. We have built a beautiful life for ourselves and I can't wait to see what our future holds. Onto the next chapter…

Table of Contents

Synopsis

Systemising involves the observation of environmental contingencies and the subsequent formulation of concrete rules to predict events. Empathising underpins social cognitive processes, and consists of two primary components, which are (I) the drive to attribute affective states to others, and (II) the ability to produce appropriate behavioural responses based on these inferences. *Hyper-systemisation* represents an unusual imbalance in the cognitive profile, where systemising abilities are significantly greater than empathising abilities. This pattern of extreme divergence in cognitive abilities is observed in those with an Autism Spectrum Condition (ASC) (Baron-Cohen, 2009). As well, anxiety disorders are frequently co-morbidly diagnosed with both primary ASC diagnoses (van Steensel, Bögels, & Perrin, 2011) and when ASC is diagnosed as secondary to a pre-existing developmental disorder, for example, in 22q11.2 Deletion Syndrome (Fine et al., 2005), and the prevalence of anxiety disorders is higher for the population on the autism spectrum than for those in the general population (Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; van Steensel et al., 2011). For those on the autism spectrum, reduced empathic functioning means that these individuals often find it difficult to find their place in a highly socially oriented society. A common assumption is that the increased prevalence of anxiety disorders observed in this population occurs as a consequence of difficulties integrating into the social environment. However, this assumption has not been evaluated experimentally, and leaves open the possibility of an inverse relationship, where increased anxiety levels make a twofold contribution, serving to both reduce the degree to which an individual can actively engage in appropriate empathising, and also, in facilitating

the development of an alternative, non-social, skillset – that which is informed by the drive to systemise.

Manipulations of anxiety have demonstrated that when in highly anxious states, individuals show reduced empathic capacity towards others, suggesting a causal influence of anxiety on empathising abilities (Negd, Mallan, & Lipp, 2011). As well, given that the fundamental function of anxiety is to facilitate preparatory responses during potentially dangerous encounters, it is likely that adopting strategies that improve the reliability with which one can predict events in the environment, for example, by systemising aspects of the environment, would be favoured, especially in high states of anxiety.

For the general population, systemising is adaptive in that it explains the general preference for daily routines, which maximise one's sense of control during everyday activities. Whilst in extreme forms, it explains the compulsive hand washing demonstrated by some individuals with Obsessive-Compulsive Disorder, and the rigid behavioural routines of individuals with ASC (Baron-Cohen, 2009). Collectively, this account suggests that high anxiety levels would reduce empathising abilities, and increase systemising abilities. The focus of the studies conducted within this thesis was to explore these possible causal effects experimentally within the general population, and to establish whether anxiety is a mechanism that drives divergence in empathising and systemising abilities.

In the first study of this thesis (see chapter 2), the hypothesised link between high anxiety levels and hyper-systemisation was demonstrated. Those high in anxiety reported low empathising and high systemising scores, and relative to their less anxious peers, also demonstrated the greatest divergence between these cognitive tendencies. Based on this initial evidence, a series of studies were

developed in order to test one possible pattern of causation – the hypothesis that an increase from baseline anxiety levels would reduce the ability to empathise whilst facilitating improvements on tests of systemising performance.

The first in this series of studies (see chapter 3) focused on better understanding the low-empathising component of hyper-systemisation. The study utilised a social exclusion paradigm called Cyberball (Williams & Jarvis, 2006), which has been shown to affect state anxiety levels. Empathic performance was assessed using a modified emotion recognition task called the Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001), both at baseline and after participation in anxiety manipulation. Results from this study suggested that participants who experienced social exclusion during the task maintained levels of state anxiety consistent with their reports at baseline, and also maintained comparable performance on the Reading the Mind in the Eyes Test throughout the study. In contrast, those who experienced group inclusion during Cyberball reported reduced state anxiety levels after their Cyberball experience, but surprisingly, demonstrated lower expression recognition accuracy on the Reading the Mind in the Eyes Test, relative to their baseline performance. This pattern of results was in direct contrast to the initial hypothesis, and as such consideration was given to the nature of Cyberball as an anxiety manipulation and its potential impact on attention allocation when processing cues to social performance, specifically, facial expressions of emotion.

In a follow-up eye-tracking study (see chapter 4), the effects of social exclusion on attentional biases to emotionally expressive faces were evaluated. Here, participants completed an expression-based dot-probe task, both as a baseline measure, and after participating in Cyberball. The dependent variables of

interest were the time to categorise targets presented in the same spatial location as expressive (happy, angry, disgusted) faces, as well as eye movements to towards these expression types. Both the reaction time and eye movement data, captured as proportion of fixations and proportion of time spent viewing expressive versus neutral faces, indicated that participants who experienced social exclusion during Cyberball biased their attention toward expressive faces (particularly angry faces) over neutral faces, whilst those who experienced inclusion during Cyberball attended more to the neutral expressions after their Cyberball experience. Whilst participants also reported changes to their state anxiety levels as a function of their participation, it was concluded that it may have been the cues to social evaluation experienced during Cyberball that facilitated hypervigilance to such information, and as such, may have contributed to superior performance when identifying facial expressions of emotion demonstrated by those who were social excluded in the previous chapter.

In the final experimental chapter of this thesis (see chapter 5), the objectives were twofold. First, we sought to develop an anxiety manipulation procedure that was free of the extraneous variability introduced when using the Cyberball manipulation. Second, we sought to demonstrate the hypothesised divergent effects of increased state anxiety on both empathising performance and on systemising performance within a single paradigm. The results of this study partially supported the anxiety-divergence hypothesis. Participants whose state anxiety levels were increased using a threat-of-shock paradigm demonstrated reduced empathic responding towards individuals depicted in distressing situations, and improved efficiency on a local/global processing task (Navon,

1977), a visuospatial task that has previously been correlated with systemising scores (Billington, Baron-Cohen, & Bor, 2008).

This thesis demonstrates that empathising and systemising performance can be differentially affected by state-based changes in anxiety levels, and that anxiety may be a key factor in exaggerating the divergence between empathising and systemising abilities. A fundamental contribution of this thesis will be to provide an informative platform from which similar investigations can be undertaken with participants who have developmental disorders e.g. autism spectrum conditions, which are characterised by both extreme imbalances in their empathic and systematic cognitive abilities, and are also known to be complicated by co-morbid diagnoses of anxiety disorders. When formulating clinical diagnoses, clinicians should seek to account for the contribution of anxiety to behaviour, particularly when relying heavily on observations of externalised "autistic" behaviours that may be exaggerated by the presence of anxiety.